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ENVIRONMENTAL NOISE IMPACT ANALYSIS FROM VEHICLE INSPECTION STATIONS

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1. INTRODUCTION

This work summarizes the analysis made for the environmental impact statement with respect to the noise that will be generated during the operation of five new vehicle inspection stations to be constructed in the City of São Paulo - Brazil. It examines potential noise impacts from vehicles travelling to and from the site, vehicles at the site, and estimates noise levels from equipment used in the stations for emission testing. The proposed facilities are open, to reduce the concentration of combustion gases, and there were concerns that operational noise levels could disturb neighbouring residential areas.

2. NOISE CLASSIFICATION OF STUDY AREA

The City of São Paulo has estabished under the Law nº 11780 of May 30, 1995 that those who are responsible for urban interventions of any kind are obliged to implement the necessary noise control measures to limit the noise levels to 71 dB(A) during the day (0600 - 2200) and to 59 dB(A) during the night (2200 - 0600).

Of the five proposed sites one is located in a strictly industrial area, two in predominantly industrial areas, one in a mixed high density area, and the other in a predominantly residential area. Contrary to the old municipal noise legislation, the new law does not establish noise limits according to zoning. This means that as far as noise pollution is concerned, these noise limits are valid for the urban space, independent of the individual categories of land uses.

Interesting enough is the fact that in all the proposed sites, but one - the site located in the strictly industrial area, noise surveys indicate that the present traffic noise levels are already beyond the limit established by the city's legislation, at least during the day.

3. TRAFFIC NOISE LEVELS

Vehicles Entering and Leaving the Facility

The normal operation of a vehicle inspection station will bring as a consequence a traffic volume increment in the vicinity of each proposed site, with an increase on the now existing traffic noise levels. The traffic noise evaluation used trip generation figures contained in the traffic impact report which has been prepared separetely. According to the present-day 1.7 million vehicles in the City of São Paulo (70% cars; 30% trucks), it is expected that each bay, in a typical 10 bay vehicle inspection station, under normal operational conditions, will attract approximately 120 vehicles per day. It is assumed that for each bay 20 vehicles will arrive during an AM peak hour and other 20 vehicles during a PM peak hour. It is further assumed that there will not be a distribution of this additional traffic among the possible travel routes to the station, meaning that a most probable route will carry this increment in traffic volume. Therefore during the peak hour, 200 vehicles will come and go (400 two-way trips), and during the out of the peak hour, 100 vehicles will come and go (200 two-way trips), for a daily 10 hours operation of each proposed station. The increase in the traffic noise levels will be given by:

$$\Delta dB = 10 \lg \left(\frac{Q_{c_o} + 10Q_{t_o}}{Q_{c_c} + 10Q_{t_c}} \right) \qquad (1)$$

where:

ΔdB = increase in the traffic noise levels due to the increment in traffic volume;

Q_c = cars traffic volume in vehicles per hour;

Q_t = trucks traffic volume in vehicles per hour;

subscript c = current situation;

subscripit o = operational situation.

According to the present traffic volumes in each of the proposed sites it is estimated that the increase in noise levels will be in the range of 0,5 - 7,0 dB(A) during the out of the peak hours, and in the range of 1,0 - 10dB(A) during the peak hours, depending on the specific location of each inspection station.

Noise surveys made on the proposed sites indicate that the present traffic noise levels are already beyond the city's limit. The only exception is the site located in the east side of the city, that according to the city's zoning is a strictly industrial area. This is due to the fact that this area is underdeveloped and still maintains its rural type characteristics. Since the operation of the station on this site will considerably increase the present traffic wolumes, the higher increment on traffic noise levels will occur on this site. The noise surveys on the sites with residential areas, and the estimated increase in noise levels from traffic accessing these sites indicate that the impact at the peak hours will be small, meaning the possibility of an increase between 3 dB(A) and 5 dB(A) on the now existing traffic noise levels. Considering that this will only happen for one AM and other PM peak hour, both

during the day, it is therefore small the traffic noise impacts from passing vehicles on sites with residential areas.

Vehicles Waiting in Queue at The Facility.

Vehicles waiting in the queue will be idling. It is unlikely that a vehicle with an obviously bad muffler would come for inspection since there will be an automatic rejection of the vehicle. Therefore it is reasonable to assume that the noise from idling vehicles will not contribute to the ambient noise levels in the area, caused primarily by the traffic flow and the operation of the equipment in the station. It is however expected that in the initial operational periods of this system of inspection, users will be rather unfamiliar with the control of noise emission from individual vehicles, and may come for inspection with conscious altered muffler systems, to add sportive sound quality to the car, or simply but not recognizing that the muffler should be changed on a noise level basis.

4. OPERATIONAL NOISE LEVELS

The significant noise sources at the facility are expected to be: i- the air discharge of the gas analysis system; ii- the dynamometer system; and iii- the engine of the vehicle being tested. The air discharge and the dynamometer manufacturers give only overall sound power levels. For enviromental noise impact analysis, it is more adequate to have the sound power in frequency bands, but despite of this difficult we still want to have an estimate of noise levels expected due to the operation of these equipment.

Noise Levels From The Air Discharge

The roof mounted air discharge will be automatically turned on only when the concentration of the combustion gases exceeds a certain limit. It is expected that this occurrence will be unfrequent due to the fact that the station building will not have important lateral closures. It is therefore assumed that the air discharge will only be activated at the station operational peak hours. For an acoustic power of 94 dB(A), the noise emissions estimate, using standard formulation for outdoor sound propagation, shows that the air discharge may not produce sound pressure levels exceeding the City of São Paulo daytime limit of 71 dB(A) upon adjacent properties, meaning that a silencer is not necessary for the air exaust system.

Noise Levels From The Dynamometers

Dynamometers are used to bring vehicles that fail the initial test up to normal operating canditions. The dynamometer is operated for 30 seconds for each of the estimate 20% vehicles that fail the initial test. Thus during the station operational peak hours an average of 4 vehicles would require use of the dynamometer. At 30 seconds per vehicle this yields 2,0 minutes during the hour for each bay, in which the dynamometer will be operating.

A statistical based simulation of the operating time of the dynamometers was developed, in which a random time was assigned to each of the 4 vehicles in each of the 10 lanes of a typical size vehicle inspection station. The dynamometers operating profile during a typical peak hour is the following.

Number of Dynamometers in Operation	Minutes During Peak Hours
al least one	17,4
one	14,7
two	2,4
three	0,3
four	0,0

With a vehicle in the dynamometer with the radiator cooling fan positioned in front of the vehicle, the sound power level is 110,8 dB(A), at a vehicle speed of 88 km/h. Based on the simultaneous use of two dynamometers, that according to the statistical simulation, is the most probable worst case possible occurrence, the sound pressure levels estimate shows that for the daytime limit of 71 dB(A), sound pressure levels above this limit are within the property limits of most vehicle inspection stations covered by this study. For those stations which can possible generate noise levels on residential areas above this limit, the following mitigative measures are recommended:

1-) treating the inside walls and ceiling surfaces with sound absorbing materials;
2-) construction of a lightweight motor operated sliding door at the entrance and exit of each bay.

The extent of the noise control required will depend upon the location of each test facility relative to adjacent properties and the zoning of these properties.

5. CONCLUSIONS

The traffic noise impact from passing vehicles are expected to be small for the residential areas located near the proposed sites, mainly due to the fact that present-day traffic noise levels are alrealy beyond the city's limit.

Sound pressure level estimates due to the equipment used in the stations for emission testing show that on most surrounding land uses no noise levels above 71 dB(A) are expected. For those stations which can possibly gerated noise levels beyond this limit upon residential areas, some mitigative measures are recommended.

The noise levels estimates from the equipment has been based on peak hours operation of the stations. During other hours, the sound levels will be lower. While some sounds from the facilities may be heard, the equivalent sound pressure levels averaged during the day will certainly be below the acceptable limits for residential areas.

6. ACKNOWLEDGEMENTS

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